Report

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East Coast oil and gas development study

Economic potential of oil and gas development

NZIER report to the Ministry of Business, Innovation and Employment

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Key points

We use a computable general equilibrium model to estimate the impact of major oil and gas developments on the East Coast region and the wider New Zealand economy.

We consider three developments devised by the Ministry of Business, Innovation and Employment (MBIE), as shown in Table 1. The scenarios range from a relatively small scale development ($387 million expected annual revenue) to a large scale, high volume development ($17 billion expected annual revenue).

Table 1 Summary of development scenarios

Annual average, $NZ million

	Small (3)	Large (4)	Large, high volume (5)
Export revenue	$387	$5,079	$17,018
Royalties	$23	$708	$2,961
Profit	$54	$1,648	$6,909

Source: MBIE, NZIER

At the national level:

- a small scale development would deliver an annual average Gross Domestic Product (GDP) gain of 0.18% or $356 million across the life of the development. GNDI[1], which excludes profits sent offshore, would grow by 0.14% or $270 million, and consumer welfare would be increased by 0.14% or $160 million
- a large scale development would deliver an annual average GDP gain of 2.7% or $5.3 billion across the life of the development. GNDI would grow by 2.2% or $4.0 billion, and consumer welfare would be increased by 2.0% or $2.3 billion
- a large scale, high volume development would deliver an annual average GDP gain of 9.3% or $18.1 billion across the life of the development. GNDI would grow by 7.6% or $14.2 billion, and consumer welfare would be increased by 6.8% or $7.8 billion
- the New Zealand economy is better off under all scenarios, even though profits go offshore. Royalties and taxes paid to the government equate to 13% of total Crown revenue or almost $8 billion per annum under the most optimistic scenario. The lasting benefits of the oil and gas development will largely be a function of how this extra revenue is spent. Investment in infrastructure and

[1] Gross National Disposable Income (GNDI) is a measure of how well-off New Zealand residents are.

institutions that improve long term productivity, or paying off debt that reduces the long term cost of capital, can ensure that the gains from the oil and gas developments continue long after the developments have ceased producing oil

- households also benefit through higher real wages. Aggregate employment at a national level is assumed to be fixed, but there is strong growth in employment in the oil and gas industry and supporting supply and investment sectors. That reflects the higher effective productivity of labour in those industries following a major find
- there are some offsetting effects as the currency appreciates reducing export returns to some sectors. This is exactly what has been seen in Australia as their mining boom has retarded the growth of other major export industries.

For this East Coast region, where the oil and gas developments are to be located:

- the small scale development would deliver an annual average GDP gain of 3.9% or $310 million, and an average annual GRDI[2] gain of 1.8% or $164 million across the life of the development. Annual employment within the region would increase by 177 jobs, of which 22 would be in industries other than oil and gas
- the large scale development would deliver an annual average GDP gain of 55% or $4.4 billion, and an average annual GRDI gain of 15% or 1.4 billion across the life of the development. Annual employment within the region would increase by 1,163 jobs, of which 185 would be in industries other than oil and gas
- the large scale, high volume development would deliver an annual average GDP gain of 182% or $14.6 billion, and an average annual GRDI gain or 39% or 3.6 billion across the life of the development. Annual employment within the region would increase by 2,347 jobs, of which 543 would be in industries other than oil and gas
- GRDI gains are lower than GDP gains because the profit and taxes flow out of the region. It is difficult to ascertain exactly how much income would remain within the region, however the impact of the oil and gas developments on other industries and employment within the region give an indication as to the likely scale of the benefits to the region
- industries such as heavy construction, engineering, retail and property grow by up to 26% under the most optimistic scenario, as a result of the increased economic activity within the East Coast. These are the industries that benefit the most from the oil and gas development
- the highly capital-intensive nature of the oil and gas industry means that the employment and transformational benefits of the developments are small relative to the GDP gains; nonetheless, average employment gains of between 0.2% and 2.4%, depending on the scale of the development, would be

[2] Gross Regional Disposable Income – this is an approximate indicator of the level of income change within the region after flows out of the region (e.g. royalties and taxes). The exact income flows are difficult to ascertain so this measure remains indicative only.

welcome in the East Coast where employment growth is low relative to the rest of New Zealand

- the oil and gas developments would also improve the economic diversity of the East Coast and deliver economic gains to a region that currently has lower economic, employment and population growth than the national average
- because the oil and gas industry is capital rather than labour intensive, uses foreign investment and a previously untapped resource, there is little 'crowding-out' of resources used by other industries within the economy.

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1. Introduction

The Ministry of Business, Innovation and Employment (MBIE) wishes to know what impact major oil and gas developments may have on the East Coast region and the wider New Zealand economy. We use a computable general equilibrium (CGE) model to estimate the long run impact of three possible scenarios.

1.1 Oil and gas development scenarios

MBIE and stakeholders developed five scenarios that represent the full spectrum of plausible outcomes for the East Coast:

- Scenario 1: Quickly abandoned exploration
- Scenario 2: Explore but no more
- Scenario 3: Small scale production
- Scenario 4: Large scale production
- Scenario 5: Large scale high volume production.

Scenarios 1 and 2 do not have commercially viable oil and gas finds. The economic impacts of these scenarios would be limited to initial investment in exploration, and so these scenarios are excluded from the analysis.

MBIE suggests scenario 3 could be described as a mid-point best estimate based on present information. Scenario 4 is an optimistic scenario between scenarios 3 and 5. Scenario 5 represents the upper end of what is plausible. For that to happen it would require both potential recovery per unit of rock and the extent of mature rock volumes to be at the upper end of their likely ranges.

The three production scenarios are of different scales and lifespans: scenario 3 is small scale finds; scenario 4 is large scale oilfields, and scenario 5 is large scale, large volume oilfields. Scenario 3 is expected to generate exports for the period 2012-2027; scenario 4 from 2012 to 2058; and scenario 5 from 2012 to 2073.

The total export revenue generated is expected to be significant. The average annual revenue generated across the life of the developments is $387 million in scenario 3; $5,079 million in scenario 4 and $17,018 million in scenario 5 (see Table 2). To put these figures in context, the value of New Zealand's exports in 2011 totalled $58,157 million.

Table 2 Average annual revenues and expenditures

$NZ million

	Small (3)	Large (4)	Large, high volume (5)
Operating costs	$114	$850	$2,331
Capital	$170	$1,269	$2,335
Royalties	$26	$603	$2,483
Corporate tax	$23	$708	$2,961
Profit	$54	$1,648	$6,909
Total revenue	$387	$5,079	$17,018

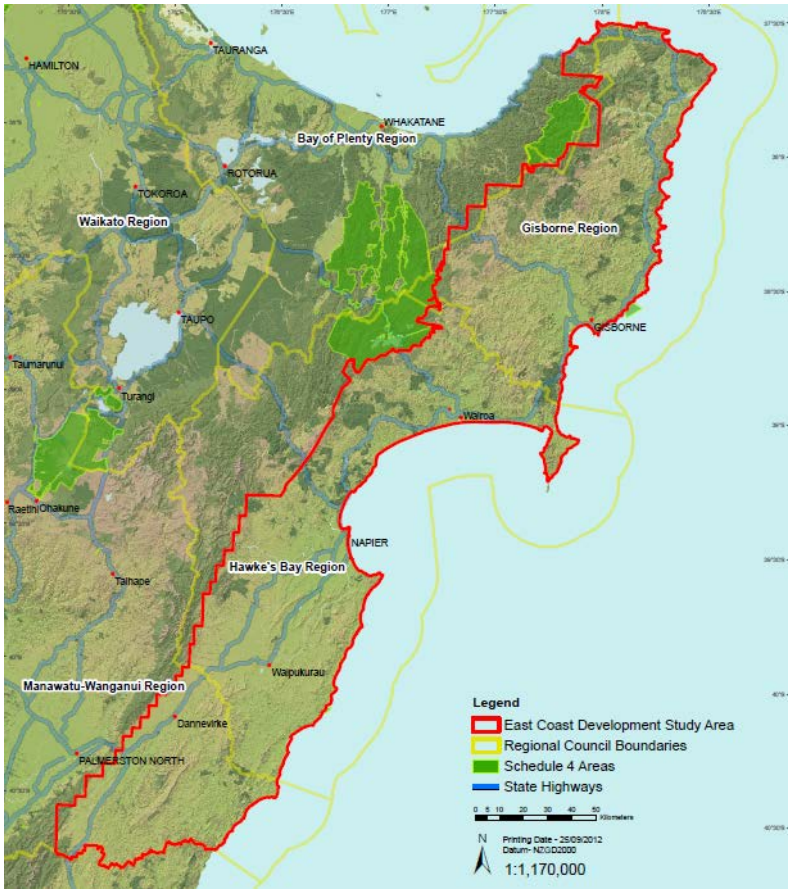
Source: MBIE, NZIER

1.2 Location

The oil and gas developments are expected to be located off the upper East Coast of the North Island, shown in red in Figure 1. The region covers a significant part of the Gisborne and Hawke's Bay Regional Councils, and the Tararua district of the Manawatu-Wanganui Regional Council (known under the trading name of Horizons Regional Council).

Due to data and time restrictions, we have used the combined economies of the Gisborne and Hawke's Bay Regions as an approximation of the economy of the study region. Some geographic areas in the study region are excluded from this approximation (e.g. Tararua district) while some geographic areas outside the study region are included (e.g. the western part of the Hawke's Bay region).

Figure 1 The study region (red boundary)



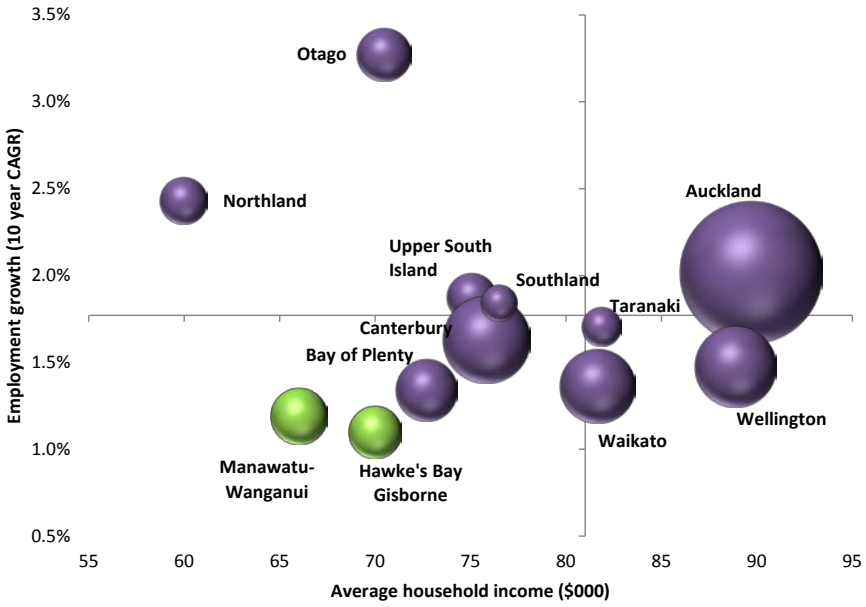
Source: MBIE

2. The East Coast region

It is difficult to generalise about an area as diverse as the East Coast. Within the East Coast, there are relatively dynamic and fast growing areas with low rates of unemployment and sound growth prospects. Elsewhere in the region, the reverse is true. On balance, the region we are studying is one which has under-performed (economically) relative to the rest of New Zealand. It is also a region for which growth prospects are not currently very strong as compared to other regions in New Zealand, such as Auckland (Figure 2).

Figure 2 Regional incomes and job growth

Bubble sizes indicate population size (Hawke's Bay and Gisborne are combined because of underlying data)



Source: NZIER, Statistics New Zealand

2.1 Socio-economic indicators

2.1.1 Population demographics

The population of the East Coast study region was 201,900 in 2011, 4.6% of the total New Zealand population.[3] It has grown by 1.9% since 2006, which is significantly slower than the 5.3% growth that New Zealand experienced as a whole. This is largely because the region experienced an estimated average net loss of 690 people per annum through outward migration between 2006 and 2011. The region has an older population than the average across New Zealand, with a median age of 38.1 years compared to 36.8 nationally.

[3] Population statistics sourced from Statistics New Zealand's sub-national population estimates (2012).

2.1.2 Employment and GDP

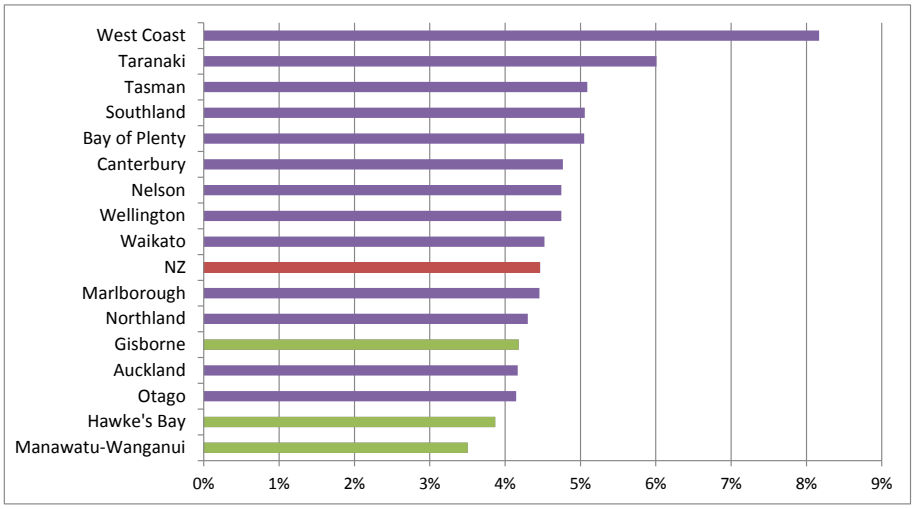
Total GDP in the East Coast study region is estimated to be $8 billion with total employment estimated at 97,000. The study region currently contributes about 5% to national employment and GDP.

Employment growth in the East Coast has been negative in recent years, declining by an average of 0.5% per annum between 2006 and 2011. This is reflected in slow growth in total gross earnings by employees in the region with nominal growth in earnings averaging 4.2% in Gisborne, 3.9% in Hawke's Bay and 3.5% in Manawatu-Wanganui over the past 5 years. National growth in gross earnings averaged 4.5% over the same period.

These recent trends are a continuation of past growth performance in the case of the Gisborne and Manawatu-Wanganui regions, where employee gross earnings grew by an average of 6.3% and 6.1% respectively between 2000 and 2007, the third and fourth lowest growth rates in the country (behind Southland and Wellington) compared to national growth of 7.0%. However, during the same period Hawke's Bay had experienced above average growth of 7.2% per annum.

Figure 3 Labour income growth 2006-2011

Nominal gross earnings compound annual growth rate



Source: Statistics New Zealand LEED data

2.1.3 Business demographics and industry mix

The East Coast study region is characterised by a high dependency on the primary sector. Gisborne has almost 4 times the national average number of people employed in the primary sector; the Hawke's Bay just over 3 times, and Manawatu-Wanganui almost 1.5 times (Table 3 Industry mix relative to national average). By contrast, the study region has smaller shares for almost all other industries.

Table 3 Industry mix relative to national average

Share of employees in region/Average share of employees nationally

Industry	Gisborne	Hawke's Bay	Manawatu-Wanganui
Primary	**3.97**	**3.06**	**1.48**
Mining	0.31	0.40	0.38
Manufacturing	0.82	1.19	0.93
Utilities	0.53	0.99	0.90
Construction	1.00	0.90	1.07
Wholesale Trade	0.45	0.62	0.82
Retail Trade	0.86	0.93	1.09
Hospitality	0.83	0.80	0.90
Distribution	0.94	0.81	0.80
ICT	0.44	0.36	0.64
Financial	0.39	0.52	0.49
Property	0.70	0.88	0.76
Profession	0.53	0.56	0.57
Admin	0.85	1.21	0.72
Government	0.73	0.68	1.58
Education	1.11	0.91	1.19
Health	1.03	1.04	1.19
Arts	0.81	0.82	0.84

Source: MBIE regional economic activity indicators (forthcoming)

A list of industry employment shares for each region is shown in Table 4. The primary sector is the largest employer for Gisborne and Hawke's Bay, and a significant employer in Manawatu-Wanganui. Government sectors such as health and education also feature prominently. Mining is the smallest employer across each of the regions.

Table 4 Industry mix by region

Share of employees in region

Industry	Gisborne	Hawke's Bay	Manawatu-Wanganui
Primary	23.1%	17.8%	8.6%
Health	11.2%	11.2%	12.9%
Education	9.9%	8.1%	10.6%
Manufacturing	9.2%	13.3%	10.5%
Retail Trade	8.7%	9.4%	11.1%
Construction	6.0%	5.3%	6.4%
Hospitality	5.8%	5.5%	6.2%
Admin	4.1%	5.9%	3.5%
Government	4.1%	3.8%	8.9%
Distribution	4.0%	3.4%	3.4%
Professional	4.0%	4.2%	4.2%
Wholesale Trade	2.4%	3.3%	4.4%
Arts	1.6%	1.6%	1.7%
Financial	1.1%	1.4%	1.4%
Property	1.0%	1.2%	1.1%
ICT	0.9%	0.7%	1.3%
Utilities	0.4%	0.7%	0.6%
Mining	0.1%	0.1%	0.1%

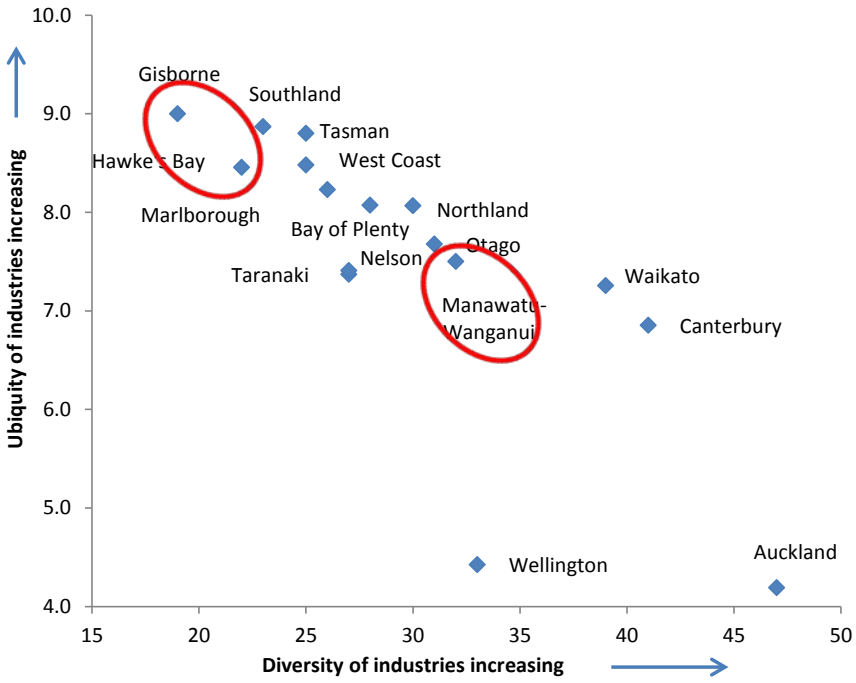
Source: MBIE regional economic activity indicators (forthcoming)

The East Coast is one of the least economically complex regions in New Zealand. Measures of economic complexity jointly summarise the degree of specialisation in an economy and the range of activities taking place in an economy. Broadly speaking, the wider the range of activities and the more specialised those activities the more complex is the economy. The degree of complexity of the economy points to the number of distinctive capabilities in an economy and therefore its growth potential.[4]

Gisborne and Hawke's Bay have some of the lowest levels of industry diversity in New Zealand and some of the highest levels of industry ubiquity across the country. High levels of industry ubiquity mean that most other regions also have the industries that Hawke's Bay and Gisborne have; there are few industries unique to the region. This does not bode well for economic growth in these regions. The Manawatu-Wanganui region has lower levels of ubiquity and higher levels of diversity, however it is unknown how this applies to the smaller Tararua district within the study region.

The East Coast has also exhibited modest performance on measures of economic dynamism. In the past decade, the East Coast has averaged 11 new firms for every 100 (or 11%) businesses already in operation. This is lower than the national average "birth rate" of businesses which is 13 new businesses for every 100 (13%) already in existence. The rates within the East Coast study region do vary though, with Gisborne and Manawatu-Wanganui recording a 10% birth rate while Hawke's Bay recorded a 12% birth rate.

Figure 4 Diversity and ubiquity



Source: MBIE regional economic activity indicators (forthcoming)

[4] See Hidalgo, C. and R. Hausmann (2009) "The building blocks of economic complexity", Proceedings of National Academy of Science, vol. 106, no. 26, www.pnas.org/cgi/doi/10.1073/pnas.0900943106.

3. Methodology

3.1 The ORANI-NZ model

The methodology we use to calculate the impact of oil and gas developments is the ORANI-NZ computable general equilibrium (CGE) model. The ORANI-NZ CGE model contains information on 105 industries and 206 commodities in its basic form. CGE modelling is a highly-respected and well-developed technique that has a rich history for assessing policy, regional and industry questions. Our model was developed in close collaboration with Monash University, a global leader in building and applying CGE models. It captures the various inter-linkages between these sectors, as well as their links to households (via the labour market), the government sector, capital markets and the global economy (via imports and exports). More technical detail on the model is presented in Appendix A.

A benefit of the CGE model is that it is based on an empirical database that identifies the structure of the industries involved. Simulating the increase in exports that the developments generate causes the oil and gas industry to expand. That, in turn, leads to investment in capital, increased employment, bigger operational budgets, and higher tax receipts for the government.

The second benefit of a CGE model is that it considers both the first round effects of the project – increased production and increased returns to capital within the oil and gas industry – as well as the impact that this first round effect has on the rest of the New Zealand economy.

On the other hand, the static approach used for this project has a number of limitations. These are presented in Appendix B. Many of the caveats mentioned could be addressed using NZIER's dynamic CGE model.

3.2 The oil and gas extraction industry

We modify the model database to include a specific new oil and gas extraction industry. The industry is split equally between the Gisborne and Hawke's Bay regions, and has an industry structure that is consistent with the data provided by MBIE (Table 5). Scenario 3 delivers profits of 14% of total revenue. This rises to 41% for scenario 5. All of the profits are assumed to go offshore. All of the new industry's production is exported.

Table 5 Oil and gas industry structure across scenarios

Average year

	Small (3)	Large (4)	Large, high volume (5)
Operating costs	30%	17%	14%
Capital	44%	25%	14%
Royalties	7%	12%	15%
Corporate tax	6%	14%	17%
Profit	14%	32%	41%

Source: MBIE, NZIER

3.3 Direct shocks

We estimate the potential contribution that a hypothetical, but realistic, natural resource find could make over the long term to the New Zealand economy. We do not explicitly model the *timing* of the developments (exploration and discovery, followed by investment and ramp up) but instead analyse a static, long-term scenario that estimates the overall contribution of the developments to the New Zealand economy. We allow capital to move in response to growth but fix the labour supply at a long run trend level.[5]

By fixing the labour supply we are taking a conservative stance on the potential impacts of the oil and gas developments. A more detailed dynamic analysis would accommodate the possibility that labour supply expands through increased migration as New Zealand becomes wealthier as a consequence of an expanded oil and gas industry.

We model three direct impacts or shocks: increased production, royalty payments, and an offshore profit payment.

3.3.1 Increased production

All production is assumed to be exported, so the first impact that we model is the increase in export quantities.[6] To model these shocks, we fix the export price and increase the supply of oil to export markets.[7] To do this, we need an 'outlet': with prices fixed, something must be causing production to increase. In this case, we allow the 'land' available to the industry to become more productive based on the increases in exports.[8] The 'land' productivity is a proxy for the discovery of natural resources.

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5 The movement in capital stocks is justified on two grounds: first, capital stocks ordinarily move with rates of return in the medium to long run. Secondly, we expect some of the investment to come from outside New Zealand, so the aggregate level of investment is also expected to rise.

6 This reflects the current situation in the New Zealand petroleum extraction industry where crude oil is exported and domestic refining activity relies on imported fuels.

7 We do not explicitly model the impacts of increased gas production as this requires a much more detailed and nuanced assessment which is not feasible in the time available for this study. If we were to model impacts on the gas market we would have to consider the feasibility of two widely different outcomes: the case where gas supply increases domestically, lowering energy costs in New Zealand versus a situation where it is economically feasible to begin exporting liquefied natural gas from New Zealand which would have the effect of driving up domestic gas prices which are currently below the international price.

8 The possible alternatives of increasing primary factor productivity or land volume are unappealing. The former implies a direct rise in capital and labour productivity, which we do not expect to occur. The latter causes a drop in the return to land, which is contrary to the stylised outcome we expect.

3.3.2 Royalties

A feature of extractive industries is the royalties that must be paid to the government. We model them as a production tax that is essentially a tax on the firm's profits, additional to the ordinary indirect taxes levied by the Crown. We assume that the government uses the revenue to reduce the nation's foreign liabilities. That assumption ensures that the royalty payment to the Crown is reflected in increased private incomes and consumption within the model.

3.3.3 Offshore profit payment

MBIE expects that foreign direct investment would be needed to develop the new oil fields in the East Coast, and therefore the profits generated from the mining will go overseas, after intermediates, capital, labour, taxes and royalties have been paid. We proxy this in our modelling by a lump-sum offshore payment of 100% of after-tax profits.

Table 6 Summary of shocks

$NZ million

Shock	Small (3)	Large (4)	Large, high volume (5)
Export revenue	$387	$5,079	$17,018
Royalties	$23	$708	$2,961
Offshore profit payment	$54	$1,648	$6,909

Source: MBIE, NZIER

3.4 Interpretation of results

Interpreting the results of the modelling requires some understanding of how the results are calculated and reported. We review the method of presentation below to aid understanding of the results presented in the following section.

3.4.1 Representative year

To capture intuitively the effect of the extraction on the country we model the impact in a representative year during operation of the field. The results can be interpreted as the persistent change in the economy due to extraction during the period that the field is operational. That means we do not capture the effect of the prior exploration and development, or the decommissioning of the wells. It also means that the effects we estimate should not be expected to persist beyond the lifetime of the field.

Note that this approach also means that we will not capture any of the fluctuations in the economy as it moves towards the steady production state that we model. These fluctuations may have significant impacts in their own right and might be captured by using a more sophisticated, dynamic modelling approach.

3.4.2 Change from baseline

The CGE technique used by NZIER calculates impacts as changes from an implicit counterfactual that is an economy without the East Coast oil and gas developments.

Results are then reported as percentage changes from the counterfactual. In order to make it easier to understand the figures we also provide dollar values for some variables. Those are calculated using current macroeconomic data so they show the dollar value that the field would have if it were in operation today. For the values to be relevant to future periods, they would need to be inflated accordingly (i.e. values are in 'current' dollars).

3.4.3 Direct and indirect effects

In analysing the modelling results we track the impacts as they flow through the economy, beginning with the direct impacts on the extraction industry itself. We then analyse the flow-on or indirect impacts. It can aid understanding to split indirect impacts into the following categories:

- **Supplying industries** – industries that supply the extraction sector with intermediate inputs
- **Household expenditure industries** – industries that households spend money on
- **Investment industries** – industries that are used for investment and capital creation
- **Export competing industries** – industries that suffer from the appreciation of the exchange rate as oil and gas exports expand.

3.4.4 Macroeconomic effects

The national results flow logically from the direct and indirect impacts. We focus on key macroeconomic variables such as employment and Gross Domestic Product (GDP), as well as Gross National Disposable Income (GNDI) which is a measure of the economic welfare of New Zealand residents (how 'well off' we are).

The scenarios will have differing impacts on GDP and GNDI, and not always in the same direction. GDP is essentially a measure of how many goods and services New Zealand produces – it shows the size of the economy. GNDI shows how much the incomes or residents increases following a change in the economy. It is more appropriate than GDP as a measure of welfare[9] and particularly appropriate for this modelling: GDP will include the production revenues that accrue to foreigners, while GNDI excludes those payments and measures the increase in incomes of New Zealand residents.

3.4.5 Regional effects

Finally, we look at how the East Coast study region is impacted. The increase in oil and gas mining is likely to have flow-on impacts within the region, to local retail and services. We report the impact on local industry activity and employment, and then comment on the total regional economic impact. This indicates how much of the benefit stays within the region and how much is experienced across the rest of New Zealand.

[9] W. Coleman, "Gauging Economic Performance Under Changing Terms of Trade: Real Gross Domestic Income Or Real Gross Domestic Product?," *Economic Papers: A journal of applied economics and policy* vol. 27, no. 4 (2008): 329–342.

4. Results

4.1 Direct effects

The direct impact of the increased production is a rise in oil and gas export revenues of $387 million, $5,079 million and $17,018 million per annum under each respective scenario, as shown in Table 7. That directly increases the wages of those working in the industry and increases the returns to capital earned by the owners of the firms working the field. It also boosts government revenues as the industry pays more taxes and royalties. Royalties rise by $23 million, $708 million and $2,961 million respectively, while commercial taxes are levied at the usual rate.

The oil and gas developments require labour. The average direct impact would be 158 new jobs under scenario 3; 587 under scenario 4; and 899 under scenario 5.

Table 7 Average annual direct gains

$NZ million unless otherwise stated

	Small (3)	Large (4)	Large, high volume (5)
Export revenue	$387	$5,079	$17,018
Royalties	$23	$708	$2,961
Offshore profit payment	$54	$1,648	$6,909
Employment (counts)	158	587	899

Source: MBIE, NZIER

4.2 Indirect effects

The flow-on impacts of increased incomes are clearly positive for industries which rely on household expenditure. Higher returns to capital and land boost households' incomes leading to increased spending in industries such as retail, property and other service sectors.

The mining services industry, a supplying industry for the oil and gas extraction industry, experiences strong growth as its engineering services are used more heavily. Sectors that provide investment services and build capital for the mining sector, such as heavy construction, also grow as the industry builds and maintains capital stocks to sustain production.

Finally, the large increase in exports causes an appreciation in the currency that reduces the competitiveness of exporters' goods. The value of exports such as dairy and horticulture decline as a consequence.

Table 8 Industry impacts

Percentage change in value added, selected industries[10]

Industry	Type	Small (3)	Large (4)	Large, high volume (5)
Mining services	Supplying	2.5%	18%	48%
Residential property	Household expenditure	0.16%	2.6%	8.9%
Supermarkets	Household expenditure	0.10%	1.3%	4.5%
Heavy construction	Investment/ Supplying	0.22%	1.7%	4.7%
Dairy	Competing exporter	-0.23%	-2.6%	-8.2%
Horticulture	Competing exporter	-0.18%	-1.9%	-6.1%

Source: NZIER

We assume that, in the long run, aggregate national employment grows only at the population growth rate; however, there are significant shifts in employment between industries generated by the development. The oil and gas industry, as well as supporting mining services, increase their employment in line with their rising output as shown in Table 7. Household expenditure industries also grow, for example, employment in the supermarket industry grows by 0.1%, 1.0% and 3.4% under scenarios 3, 4 and 5 respectively. In addition, there is a rise in the average real wage of 0.13%, 1.4% and 4.7% respectively, as discussed in the next section. These movements are reallocations of labour resources, rather than aggregate growth, and are offset by job losses in shrinking export industries. The horticulture industry for example sheds 0.4%, 2.9% and 9.2% of its workforce under the different scenarios.

4.3 National effects

The economy benefits from the wealth generated by utilising previously dormant resources, resulting in increasing wages and returns to capital for the natural resources sector.

The net result for the three scenarios is an increase in GNDI of 0.14%, 2.2% and 7.6% respectively. If operational today, this would be worth $270, $4,045 and $14,155 million. This equates to increases of $61, $910 and $3,183 in per capita incomes.

The rise in GDP is even greater at 0.18%, 2.7% and 9.3% respectively. The main reason for the large difference between GNDI and GDP changes is the payment of profits offshore. That revenue boosts GDP but doesn't end up adding to the income of New Zealanders. In addition, some of the GDP is diverted to investment to take advantage of the attractive rates of return offered by the mining sector. That generates increases in the nation's capital stock of 0.29%, 2.4% and 5.6% in total.

[10] Selection is based on Section 3.4.3. They provide a good indication of the impact of various types of flow-on effects.

Overall, the increase in export values generates higher incomes for New Zealanders, which leads to an increase in our wealth and, thus, our living standards. Compensating variation, a consumer welfare measure that shows how much better or worse off consumers are after a change, grows by $160, $2,280 and $7,832 million under the three scenarios respectively.

However, not all sectors of the economy benefit. In particular, the appreciation of our exchange rate has a negative impact on competing exporters. This is exactly what has happened in Australia as their mining boom has retarded the growth of other major export industries.

While the appreciation in currency negatively impacts exporters, it allows consumers to access cheaper imports from overseas, as can be seen by the rise in import volumes.

Overall, the rise in oil export value dominants the balance of trade. It improves by $157 million under the small scale development, rising to almost $9 billion under the large scale, high volume development. For context, typically New Zealand runs a small balance of trade deficit where imports exceed exports, but in any given year the balance of trade typically falls between -$3 billion and $3 billion. The two larger scenarios would therefore very likely deliver balance of trade surpluses.

There has also been a rise in Crown revenue as the increased economic activity generates indirect tax (predominantly GST) revenues, in addition to the increased royalties. Royalties plus the gains indirect tax revenues sum to $65, $1,251 and $4,784 million for the three scenarios respectively, as a consequence of the oil and gas development. This is in addition to the extra corporate tax paid by the oil and gas developments of $23, $708 and $2,961 million, as shown in Table 2. To put this in context, total Crown revenue in the 2011/12 year was $60.6 billion[11], so the developments would make a sizeable contribution to the Crown's fiscal position and help reduce national debt.

For the purposes of this simulation we assumed that government expenditure moves in step with private consumption; any additional government revenues are used to pay off overseas debt. Consequently, we may underestimate the value of additional government revenues if they would be of more value to the Crown than to households.

Table 9 Summary of national results

% change versus baseline; $NZ million

	Small (3)		Large (4)		Large, high volume (5)	
Metric	**%**	**$m**	**%**	**$m**	**%**	**$m**
GDP	0.18%	$356	2.7%	$5,259	9.3%	$18,101
GNDI	0.14%	$270	2.2%	$4,045	7.5%	$14,155
Consumer welfare	0.14%	$160	2.0%	$2,280	6.8%	$7,832
Exports (volume)	0.29%		4.6%		16%	
Imports (volume)	0.11%		1.2%		3.7%	
Balance of trade (nom)		$157		$2,570		$8,973
Real wage	0.13%		1.4%		4.6%	

[11] http://www.treasury.govt.nz/government/revenue

Real exchange rate	0.15%		1.7%		5.5%	
Capital stock	0.29%		2.4%		5.6%	
Indirect taxation (incl. royalties)		$65		$1,251		$4,784

Source: NZIER

4.4 Regional results

The oil and gas developments generate direct economic activity and employment for the East Coast. There are a range of further industries located within the East Coast that benefit from this economic activity. Retail, service and property industries in particular benefit from the increased incomes within the region, as shown in Table 10. These 'regional multipliers'[12] mean that the study region benefits over and above the direct gain from the oil and gas developments.

Table 10 East Coast industry impacts

Percentage change in value added, selected industries for the East Coast region[13]

Industry	Type	Small (3)	Large (4)	Large, high volume (5)
Heavy construction	Investment/ Supplying	0.22%	1.7%	4.7%
Residential property	Household expenditure	0.5%	5.1%	16%
Real estate	Household expenditure	1.3%	9.6%	26%
Supermarkets	Household expenditure	0.6%	7.2%	23%
Food outlets	Household expenditure	0.5%	5.3%	17%
Local government	Services	0.3%	3.2%	11%
Horticulture	Competing exporter	-0.2%	-1.9%	-6.1%
Dairy	Competing exporter	-0.2%	-2.6%	-8.2%

Source: NZIER

As a result of the increased activity, regional employment also grows. East Coast employment in the oil and gas industry increases on average by 177 under the small scale development, 978 in the large scale development and 1,804 under the large scale, high volume scenario. We find further employment gains in the East Coast of 22, 185 and 543 for the three scenarios, over and above those directly employed in the oil and gas

[12] We use the 'mulitplier' term to explain how regions can benefit over and above direct shocks, but the results calculated here are derived from a CGE model analysis that considers resource constraints and price changes, not flawed IO model multiplier techniques that ignore these issues.

[13] See footnote 10.

developments. This means the developments generate an extra 0.2%, 1.2% and 2.4% employment on average for the East Coast.

Table 11 Average East Coast employment gains

Employee counts

	Small (3)	Large (4)	Large, high volume (5)
Oil and gas	177	978	1,804
Other industries	22	185	543
Total	199	1,163	2,347

Source: MBIE, NZIER

The impacts on the overall East Coast economy are large. Regional GDP grows by 3.9%, 55% or 182%. This would be worth $310 million, $4,362 million or $14,556 million if the developments were operational today.

The vast majority of the GDP gains from the developments flow to the study region; however, there are wider flow-on impacts to the rest of New Zealand, which sees gains of $46 million, $897 million and $3,545 million for the three scenarios respectively. These flow-on impacts accrue as benefits 'leak' out of the study region: the oil and gas development uses inputs from other regions; some of the income generated from the development is spent on goods and services from wider New Zealand; and benefits from the royalties gained from the development are widely distributed across New Zealand.

Table 12 Summary of regional GDP results

% change versus baseline; $NZ million

	Small (3)		Large (4)		Large, high volume (5)	
	%	$m	%	$m	%	$m
East Coast study region	3.9%	$310	55%	$4,362	182%	$14,556
Rest of NZ	0.0002%	$46	0.48%	$897	1.9%	$3,545

Source: NZIER

While the economic activity increase (as measured by GDP) is largely confined to the study region, the income benefits (as measured by GRDI – Gross Regional Disposable Income) are much more evenly spread across the country. This is because royalties and tax payments from the oil and gas developments flow to the Crown. The GRDI improvements for the study region are 1.8%, 15% and 39% under each of the three scenarios respectively. These are still very significant gains, but lower than the GDP gains for the region.

However, we caution that the GRDI results are indicative only as income flows across the country are particularly difficult to ascertain.

Table 13 Summary of regional GNDI results

% change versus baseline; $NZ million

	Small (3)		Large (4)		Large, high volume (5)	
	%	$m	%	$m	%	$m
East Coast study region	1.8%	$164	15%	$1,414	39%	$3,613
Rest of NZ	0.1%	$106	1.5%	$2,631	5.9%	$10,542

Source: NZIER

4.5 Implications

We noted in Section 2 that the East Coast is underperforming compared to the rest of New Zealand for economic growth, employment and population. There is a lack of economic diversity, which limits potential growth.

The oil and gas developments would improve the diversity of the region and deliver strong economic gains. The developments significantly increase regional GDP, by as much as 182% in the most optimistic, large scale, high volume scenario. This would deliver a step change in economic growth for the region.

However, GDP simply captures the value of economic production within the region. It increases because a previously untapped resource is now used to generate significant value of exports. The impact of the developments on the study region will be much less than the large percentage increases in regional GDP imply.

A good way to understand the implications for the study region is to look at how other industries and employment are impacted. Industries such as heavy construction, engineering, retail and property grow by up to 26% under the most optimistic scenario, as a result of the increased economic activity within the East Coast. These are the industries that benefit the most from the oil and gas development.

Overall, the East Coast sees average employment gains of between 0.2% and 2.4%, depending on the scale of the development. These gains would be welcome in a region where employment growth is low relative to the rest of New Zealand. The highly capital-intensive nature of the oil and gas industry means that the employment and transformational benefits of the developments are small relative to the GDP gains.

One benefit of the structure of the oil and gas industry is that there is little crowding out. Typically, when a sector grows as strongly as the oil and gas sector would under these scenarios, other sectors are crowded out by the competition for resources. For example, as the dairy industry has grown, the sheep and beef industry has declined. However, because these developments use relatively little labour, foreign investment for capital and a previously untapped resource, the crowding out impacts on other industries are small.

The one exception to this is the appreciation of the exchange rate that is a consequence of the increased oil exports. This negatively impacts on other exporting industries, such as the primary sector.

One of the most significant impacts of the oil and gas development is on Crown fiscal position. The extra corporate, GST and royalty revenue has the potential to increase Crown revenues by 13% or almost $8 billion per annum. The lasting benefits of the oil

and gas development will largely be a function of how this extra revenue is spent. Investment in infrastructure and institutions that improve long term productivity, or paying off debt that reduces the long term cost of capital, can ensure that the gains from the oil and gas developments continue long after the developments have ceased producing oil.

Appendix A CGE modelling framework

A.1 ORANI-NZ

Our results were produced on a model of the New Zealand economy based on a tried and tested generic model (ORANI-G) that has been found to be effective for policy analysis in Australia and around the world. The model has been calibrated to the local setting and loaded with New Zealand data. The assumptions needed are based on consultation with industry specialists and reflect best practice.

The model has been developed with considerable assistance from CGE modelling experts at the Centre of Policy Studies at Monash University in Melbourne Australia.

A.2 Database structure

The model is based on a large database containing the value flows of the economy. The database defines the initial structure of the economy, which by definition is assumed to be in equilibrium in all markets. The structure of the database is similar to traditional input-output tables; for example, commodities may be used as intermediate input for further production, utilised in investment, exported or consumed by households and the government. Industry costs include the cost of intermediates, margins, taxes and primary factor costs for labour, land and capital. As per the accounting identities in input-output tables, the total value sum of producers' input costs (including margins, taxes, returns to factors and other costs) equates to the total value of output production (the 'MAKE' matrix in the database).

The ORANI-NZ model consists of:

- 106 industries
- 205 commodities
- 1 household.

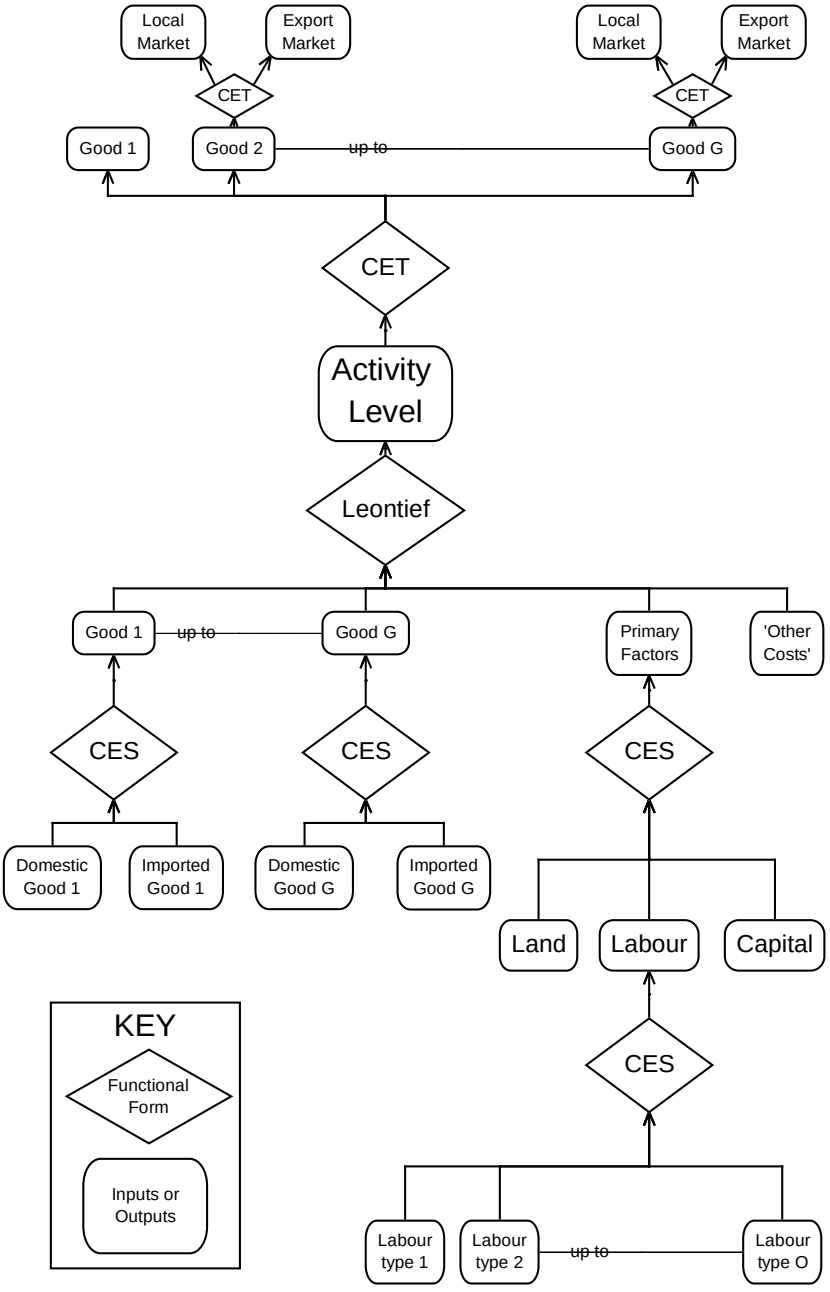
The database was sourced initially from Statistics New Zealand 2007 Inter-Industry tables, and 'up-scaled' to 2011 levels using latest Statistics New Zealand macroeconomic data.

A.3 Production structure

The production structure of the model is presented in Figure 5.[14] Each industry can produce a number of different commodities. Production inputs are intermediate commodities, both domestic and imported, and primary factors labour, land and capital. Working from bottom to top, we see constant elasticity of substitution (CES) production nests for occupations, primary factors and the choice between imported and domestic commodities. In this case, an increase in price moves sourcing towards another input, for example, if the price of imports increases, more domestic commodities are demanded in the intermediate sourcing CES nest.

[14] Mark Horridge, Monash University. Centre of Policy Studies, and IMPACT Project (Australia), *ORANI-G: A General Equilibrium Model of the Australian Economy* (Centre of Policy Studies, 2000).

Figure 5 Production structure



Source: Horridge, 2000

At the activity level, intermediate goods, primary factors and other costs are combined using a Leontief production function. This means the proportion of production inputs does not change. On the output side, there are two further constant elasticity of transformation (CET)[15] nests. The production mix of each industry is dependent on the relative prices of each commodity. Similarly, the export nest determines local and export market shares depending on relative prices.

[15] A CET function is identical to a CES function except that the transformation parameter has the opposite sign (i.e. increasing price increases output in a CET; in a CES, increasing price reduces demand).

Appendix B Modelling caveats

As with any economic modelling approach, the technique we have employed has its limitations. These caveats include:

- We have used a productivity shock to deliver the increased wealth that the developments will generate. This is a simplification of how the projects will operate.
- The analysis is static, looking at the impacts of the developments on the New Zealand economy at a point in time many years in advance. In reality, the benefits of the developments will be spread across the life of the projects, initially with investment into the facility increasing demand for construction and building; operational expenses including demand for intermediate inputs and labour; supply of fuel after the facility is running; and taxation revenue varying across the project lifetime. We do not explicitly model the dynamics of the developments over time.
- The oilfield project will generate carbon dioxide emissions. However, we have not included the cost of carbon explicitly within this modelling because we are unsure of the parameters of any international agreement.
- While the model database is highly disaggregated, it still invariably suffers from aggregation bias – we are modelling the entire oil and gas industry rather than one firm.
- The CGE model is based on Statistics New Zealand Input Output tables, with decisions based on neoclassical economics. Structural changes to the economy from the developments are therefore not captured in the modelling, nor are any non-competitive market structures. This means the actual distribution of costs and benefits may differ in reality if firms with market power absorb price and cost movements in their profits.